COMMENTS ON CALFED'S DRAFT EIS OF MARCH 1998

for
Save San Francisco Bay Association

NATIONAL ECONOMIC RESEARCH ASSOCIATES

444 MARKET STREET, SAN FRANCISCO, CALIFORNIA 94111
TELEPHONE: *415.291.1000* FACSIMILE: *415.291.1020*

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nera

Consulting Economists

I. INTRODUCTION AND SUMMARY

At the request of Save San Francisco Bay Association, National Economic Research Associates (NERA) has reviewed the CALFED's Draft Programmatic Environmental Impact Statement (EIS) of March 1998, especially the Water Use Efficiency Component Technical Appendix, and the California State Department of Water Resources (DWR)'s Bulletin 160-98 public review draft (the Bulletin).

The EIS relies heavily on the work of the DWR's Bulletin. As a result, we have addressed some of the methodological problems presented by this document in commenting on the EIS. The DWR produces the Bulletin every five years as required by the California Water Code to provide guidance for state water policy and planning. Our review of the Bulletin raises serious concerns regarding the DWR's forecasts of water supply and demand and the methodology for evaluating supply and conservation options. These flaws undermine the DWR's conclusions regarding the need for new water supplies and the most attractive options for meeting demand increases. The CALFED EIS suffers accordingly.

We have also critiqued CALFED's Water Use Efficiency Component Technical Appendix. The reasoning in this document also suffers from many of the same flaws as those found in the Bulletin. Moreover, the Technical Appendix also fails to consider economic efficiency in addition to physical efficiency, and thus is not a reliable guide for policy analysis.

II. THE DEPARTMENT OF WATER RESOURCE'S BULLETIN 160-98

The Bulletin, as it stands, is inadequate for the purposes to which CALFED has applied it. Not only does it fail to adequately account for supply and demand, it unnecessarily focuses on supply/demand equilibrium within hydrologic regions as its primary objective. This focus reflects the traditional central planning approach to water resource management, which fails to fully recognize the importance of market forces in achieving the most efficient allocation of water resources.

The Bulletin also fails to adequately account for the fact that different water-related projects have different objectives—not all projects are primarily intended to increase supply or reduce demand. Some projects are principally designed to protect or enhance the environment while others are intended to provide flood control. This distinction is not adequately captured in the evaluation framework employed by DWR to recommend the most attractive water supply and management options.

A. Overview Of Bulletin 160-98

The Bulletin presents the Department of Water Resources' (DWR) most recent supply and demand water forecasts indicating that without further government action, California will face a water shortfall of 2.9 million acre-ft by 2020 in an average year. The projected shortfall is greater in a drought year, 7.0 million acre-ft by 2020. Three regions—South Coast, San Joaquin River and Tulare Lake—account for over 75 percent of the shortfall in an average year and 66 percent of the shortfall in a drought year. For most regions, the shortfall is a small fraction of that region's total demand, not accounting for any new facilities or program implementation. In fact, 7 out of the 10 hydrologic regions have shortfalls measuring less than 10 percent of each region's respective demand for water in any average year. Even in drought years, 4 out of 10 regions are predicted to experience shortfalls less than 10 percent of each region's total demand.

The DWR recommends a series of regional and statewide options to meet the forecasted deficits, but comes up 1.38 million acre-ft short in an average year and 3.94 million acre-ft in a drought year. Eighty-five percent of the average year shortage is projected to occur in two regions—San Joaquin and Tulare Lake. Approximately 56 percent of the average year shortage is expected to occur in the San Joaquin River Region and another 30 percent in the Tulare Lake Region. These regions jointly account for 69 percent of the projected drought year deficit, with San Joaquin River contributing 39 percent of the total drought year shortage and Tulare Lake contributing 30 percent to the total.

The DWR recommended supply options would add 1.04 million acre-ft in an average year by 2020. Recommended demand management options (conservation, recycling, and some transfers) constitute less than one percent of total projected demand, a reduction of 0.5 million acre-ft. In a drought year, recommended supply options amount to 2.54 million acre-ft with demand management efforts measuring roughly the same as in an average year, again, 0.5 million acre-ft.

B. Issues Relating To DWR's Determination Of Water Supply And Demand

Below we present our concerns regarding the DWR's water supply and demand forecasts and the methodology used for recommending options to meet projected deficits. Overall, we have concluded that the uncertainties and omissions in DWR's forecasts are sufficiently large that the projected deficits are highly speculative. In addition, the DWR's recommended water supply and demand management options are questionable because the Department's methodology fails to adequately account for the benefits and costs of the various options and fails to adequately account for potential tranfers between regions.

1. Water Supply

The DWR's projection of water supply to the year 2020 is inadequate for two principle reasons, both linked to a basic failure to adequately account for supply responses to changes in demand. First, it ignores interregional transfers and restricts out-of-state transfers to those already identified. Second, it fails to account for within-region supply responses to price increases.

a. Treatment of Water Transfers

Although the DWR allocates state-controlled water supply sources to the various hydrologic planning regions, it does not provide for trading between the regions beyond existing agreements. This ignores what appear to be substantial opportunities for trade even using DWR's questionable option-ranking system. For example, DWR projects a water deficit in the Tulare Lake Region in 2020 of 408 taf after accounting for statewide options at costs of up to $175 per acre-ft and local options at costs of up to $500 per acre-ft. At the same time, DWR does not recommend several recycling options available in the South Coast that it determined are unneeded to meet South Coast demand, which could provide over 200 thousand acre-ft at a cost of $500/acre ft or less. These projects could, for example, reduce South Coast demand for state water, allowing for more water to flow to Tulare Lake. Such a transfer would be attractive if South Coast recyclers could sell to Tulare Lake users.

b. Supply Responses to Price Increases

The DWR does not address the issue of water price in Bulletin 160. No price forecasts are presented. If prices rise, however, supplies in the form of greater recycling, efficiency improvements, and new technologies will be created. Although the DWR recognizes these possible responses, it only includes already-committed responses for the most part. Additional responses resulting from higher prices are not incorporated into the supply estimate. Advanced technologies are identified but not recommended because of high capital and operating cost projections. These options may become economic with water price increases.

2. Water Demand

The DWR's water demand forecast is extremely simplistic and apparently not influenced by possible water price changes. Although the DWR devotes a section of the Bulletin to urban and agricultural water price elasticities, these values are not clearly employed in the demand forecasts. Moreover, there is no discussion of water price in the Bulletin. Clearly, increases in water prices should be expected and may be necessary for the successful implementation of many of the identified projects in the Bulletin. Price increases are also critical to the case in which, as projected by the Bulletin, demand outstrips supply. Pricing alone could result in more conservation, more crop substitution, more land retirement and more transfers than are currently incorporated in the DWR forecasts.

Nowhere is this deficiency more apparent than in the urban demand forecasts for the Tulare Lake and San Joaquin River regions. In these regions, which are expected to face the most substantial deficits, urban water use per capita is assumed to fall modestly. Per capita consumption in Tulare Lake is forecasted to fall from 311 gallons per capita per day (GPCD) in 1995 to 274 GPCD in 2020, assuming the existence of some baseline conservation measures. Similarly, San Joaquin River per capita urban consumption is projected to fall from 301 GPCD to 269 GPCD by 2020. Comparing these consumption levels to those of San Francisco or Los Angeles suggests that much lower consumption is possible. In view of the forecasted shortages, higher prices could go a long way toward reducing the forecasted deficit. If, for example, Tulare Lake urban consumption were to fall to the state average (a reduction of almost 26 percent), the deficit for that region, assuming a budget with existing facilities and programs only, might fall as much as 19 percent in a drought year and 47 percent in an average year. Substituting the statewide urban consumption rate into Tulare Lake's budget that includes the Plan's recommended options, the region's shortage might decrease by 34 percent in a drought year and by as much as 86 percent in an average year by 2020.

C. Integration of Supply and Demand

Integrating supply and demand is essential for establishing the value of water and for determining the most efficient allocation of water resources. The efficient allocation is defined where the marginal benefit of water supplied equals the marginal cost of supply. The DWR, however, does not attempt such an integration. Instead the DWR recommendations are based on an option scoring method, which inadequately accounts for the costs and benefits of the options considered. As a result, the DWR cannot demonstrate that its recommendations would result in an efficient allocation of water resources.

1. Matching Supply and Demand

The DWR presents very little on the integration of supply and demand in the Bulletin. Each region is treated independently with respect to supply and demand with the exception of the allocation of state water supplies and a few previously arranged transfers. No attempt is made to optimize available and potential supply with projected demand. This ignores what appear to be substantial opportunities for trade across regions. According to the DWR's numbers, several regions could, for example, provide water to Tulare Lake and San Joaquin at costs lower than those available within those regions.

2. Valuing Water

Perhaps most importantly, the DWR approach fails to recognize that different users place different values on water, water quality and water reliability. For example, the DWR does recognize that there is a tradeoff between the costs of programs to create supply during a drought, noting:

> Agencies may evaluate the marginal costs of developing new supplies and may conclude that the costs of their development exceeds the cost of shortages to their service areas, or exceeds the costs of implementing measures such as transfers or rationing (p.10-10 to 10-11).

Unfortunately, the DWR does not explicitly make such tradeoffs in its own review of water management options. In fact, the DWR approach results in a set of recommended options designed to alleviate drought conditions without clearly identifying the costs of these options or the consequences of not implementing them. Consequently, agencies are not given any guidance by the Bulletin to make the necessary tradeoffs. Moreover, to the extent that the DWR has applied this approach in deciding to leave the Tulare Lake and San Joaquin Regions in deficit, this rationale has not been clearly stated within the report.

3. Option Ranking

The DWR employed a simple and highly arbitrary ranking method to determine which supply and demand options to recommend in each hydrological region. Each project was ranked on a 0 to 4 scale (4 being the most favorable) in six categories: Engineering, Economics, Environmental, Institutional/Legal, Social/Third Party, and Other Benefits.

Thus, the maximum possible score for an option is 24 points (6x4). This approach does not allow for a rational comparison of options within regions or between regions. All categories are given the same weight or importance. Following this method allows for unlikely outcomes. For example, a project with a cost of $150 per acre-ft and scores of four in the engineering, economics, environmental, but scores of 1 in the remaining categories (therefore, a total score of 15) would be ranked lower than a project with a cost of $500 per acre ft and scores of 2 in the engineering, economics and environmental categories, but scores of 4 in the remaining attributes (therefore, a score of 18). This suggests that the other categories impose costs on society in excess of $350 per acre-ft (the difference between 500 and 150). Is society really willing to pay such a premium? Although DWR analysts may consider institutional or other benefits low, without clearly identifying the tradeoff between options there is no way for the public to choose between options.

One important tradeoff hidden by the Bulletin's current evaluation approach is the ability to value more flexible, short-term options for meeting demand against more capital intensive long-term options. None of the Bulletin's option categories account for this tradeoff. Ironically, it may be one of the most valued characteristics to evaluate considering the economic, engineering and environmental impact of choosing a lower-risk, less vested option that will avoid amassing potentially gross capital expenditures in the future especially if the demand shortage is temporary or short-lived. This issue is better known as the "stranded cost" issue and has been at the center of several heated public debates over who should bear the cost of sunk investments that cannot be recovered.

The potential stranded cost problem can be seen in the DWR final recommendations at the state-level. The distribution of supply-side and demand-side options looks very different when comparing the average year to the drought year. As illustrated in Figure 1, local demand options in an average year constitute approximately 28 percent of total water supplied by the Bulletin's recommended options with local supply options providing 35 percent of the total and statewide options filling in the remainder. Under drought conditions, the role of local supply options jumps from 35 to 56 percent. Thus, the DWR is recommending substantial investment in supply to meet drought conditions. Local agencies are being encouraged to build capacity they may rarely, if ever, need. This contradicts the DWR's own observation that drought-related investments must be compared to the cost of enduring the drought and leaves local agencies at risk of incurring stranded costs.

The DWR approach fails to adequately define how much benefit or value each option provides and to whom. For example, an option may provide 100 acre-ft at a cost of $500 an acre-ft, but urban water users are only willing to pay $300 because it is cheaper to conserve or use another source. At the same time, society may be willing to pay $600 for the 100 acre-ft to protect an endangered species. The best the DWR framework can do is score this project high on the environmental category. There is no way to assign the option a specific value to compare against the options cost and against other projects.

This problem can be avoided by employing a benefit-cost approach to valuing alternatives. The benefits of each option would include the amount of water provided or saved and other characteristics such as flood control and environmental protection. These characteristics can be quantified in dollar terms. Benefits of flood control can be determined by the value of flood damage avoided. Environmental protection benefits can often be estimated as well. Economists have several tools designed to estimate wildlife and recreational water uses. Even if dollar values cannot readily be assigned for these uses, a more explicit accounting of the environmental gains or issues are necessary to make informed decisions regarding water supply and management options. For example, one option may protect a large fraction of an endangered fish species while another may protect an endangered plant. A direct comparison of this sort rather than a rank of 0 to 4 enables policy makers to make clearer tradeoffs.

Option costs would include the capital and operating costs. These costs could incorporate the cost of uncertainty regarding performance not to mention demand. Note that this would avoid the need for an engineering score. Costs would also include any potential environmental damage.

Projects would then be ranked on a net benefits (benefits-costs) basis. These rankings would account for the characteristics identified by the DWR and explicitly account for the value of each option. Options would be recommended in order from highest to lowest net benefits sufficient to meet projected demand and allow for all economic trades between regions Note that this method can accommodate options with benefits and costs not readily quantifiable because it provides the means to explicitly identify the tradeoffs between options.

III. CALFED'S DRAFT PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

Beyond the methodological problems that pervade the DWR Bulletin and, as a result, the CALFED EIS, we focus here on the CALFED EIS' technical appendix's failure to consider economic efficiency.

A. Defining Efficiency

CALFED adopts a conventional physical definition of efficiency: minimize the ratio of water applied to water consumed. From a planning perspective, a more appropriate objective is economic efficiency: maximize economic value produced with a given amount of water. This definition applies at the farm-level, as well as the regional or state level. At higher levels of aggregation, however, maximizing economic value may well require reallocating water supplies, by regulation or by markets, among sectors of the economy and geographic areas.

There is an important distinction between farm-level and regional water use efficiency. Farm-level efficiency is most commonly expressed as the ratio of crop evapotranspiration (ET) to applied water for a specific farm. Regional efficiency considers more than just one farm. The CALFED analysis implicitly assumes that conservation only produces "real" savings in areas where return flows are lost to the system (e.g., near the coast or in areas with saline groundwater). This assumption is quite strong, and biases the analysis against conservation. For example, there is considerable evidence that adoption of low-volume irrigation systems in agriculture can reduce evaporation, particularly on immature vineyards and orchards. This is a physical issue that deserves greater attention in the document.

There is an even more serious problem with CALFED's basic conceptual framework. The analysis fails to consider economic values and tradeoffs between various uses of water. For example, the analysis assumes that agricultural conservation provides no benefit to the state's water system unless the farms in question overlie saline groundwater, in which case the return flows would be lost in any case. However, even if regional physical efficiency is high, diversion harms instream habitat (which has an economic cost) and the economic value produced with diverted water may not justify this degradation from a societal point of view. To take another example, water used in the urban sector frequently has a higher marginal productivity than water used in agriculture. From an economic perspective, efficiency and social welfare may be increased if water is reallocated from agriculture to urban areas, with no increases in diversions.

The failure of the efficiency analysis to consider economic values is even more distressing when considered in light of a potential outcome of the CALFED process: construction of expensive new storage facilities to stabilize and increase diversions. It is probable that some current uses of water already diverted generate less economic value per acre-foot than the marginal cost of providing new supply. CALFED should make this comparison, and if the results are as hypothesized this is a strong argument against new construction. Simply put, CALFED should investigate how well we are using current supplies before recommending construction of new facilities. A more appropriate efficiency analysis would measure the economic value (i.e., revenue, profit, consumer surplus) produced in various regions by urban and agricultural water consumption.

Measuring willingness to pay for existing supplies would also give CALFED a way to judge the desirability of proposed conveyance facilities. Current limitations on transfers are due in part to conveyance constraints and environmental regulations governing the Delta.

Once economic values of water were computed along the lines suggested above, the CALFED staff would be able to measure the gains from additional trades resulting from construction of various conveyance facilities. These social gains could then be compared to construction and operating costs.

B. Financial Incentives

Even if one adopts the strict physical definition of efficiency, economic factors enter the picture in another way: farmers will use water as efficiently as financial incentives dictate. Numerous economic studies have demonstrated that water use changes as farmers receive different price signals about the value of water. Recent research conducted at UC Berkeley under a Challenge Grant from the Bureau of Reclamation has painted a more complex picture of on-farm water use than existed previously. As detailed in annual reports to the Bureau, this research has shown how environmental and economic factors interact to influence water management at the micro level.

Farmers have several potential responses to changes in water price: fallowing, technology adoption, crop shifting and more intensive management. Generally, decisions such as fallowing and management that do not require significant up-front outlays are adopted in the short-run. Crop shifting and irrigation technology investment are longer-term responses. One important conclusion of the UC Berkeley research is that soil quality and weather conditions play a large role in determining land allocation and technology choice. Thus, the response to water price is optimized to local growing conditions.

Due to the importance of local factors, financial incentives are likely to outperform best management practice regulations that dictate on-farm water use. It is reassuring that the document recognizes this explicitly and emphasizes incentives over regulatory actions. Regulatory actions such as BMPs may actually reduce efficiency as a result of their one-size-fits-all nature.

Given the importance of financial incentives, it is worth reviewing some evidence on how farmers respond to various types of price reforms. This data was generated by the UC Berkeley team of economists working under the Challenge Grant described earlier.

C. Volumetric Water Pricing

In the spring of 1995, Arvin-Edison Water Storage District (AEWSD) altered its rate structure from contracted water allotments to use-based allocation. Historically each grower had been contracted a given allotment of water per acre. If growers desire more, they may either pump ground water or purchase additional water from the AEWSD, if available. With the change in the rate structure growers are no longer limited to a specific quantity of water and the variable portion of the charge has been increased to discourage excessive water use. One of the specific goals of this policy change was to target some water uses that the AEWSD thought were wasteful, especially pre-irrigation and other year end irrigation activities.

Prior to the rate reform, when growers had water left over at the end of the year they would typically use it on low value cover crops, such as hay, or use it for pre-irrigation. This use of water did not produce much value added, but growers perceived the water was already paid for since it was specified in the contract.

To date, there appears to be a measurable response to the change in the rate structure. For example, there was a 1,200-acre reduction in hay and a 900-acre reduction in small grains, both of which tend to be low-value cover crops. There was also an 800-acre increase in potatoes, a 400-acre increase in onions and a 500-acre increase in miscellaneous truck crops, all of which are considered medium- to high-value crops. The end result of the change in the rate structure appears to be a small increase in water use per acre (which is achieved with a reduction in the total number of acres farmed and a reduction in potentially uneconomic practices such as pre-irrigation and double-cropping), and an increase in the economic value produced per acre-foot of water applied.

D. Water Trading

Water trading among growers serves many of the same functions as increasing the price paid to the district. Water trading can increase the marginal price of water; significantly, it also avoids the revenue neutrality requirements that hamstring most district-implemented conservation measures such as tiered pricing and buybacks. There are three basic conclusions of the Challenge Grant work on trading within Westlands Water District: 1) there is extensive participation in the internal market, 2) the water market helps growers cope with surface supply fluctuations and 3) water trading has especially important benefits to small landowners.

1. Level of Market Activity

The volume of water traded within Westlands ranged from a high of 410,493 AF in 1995 to a low of 284,540 AF in 1994. When measured in terms of the share of the CVP water supply, the market was actually more active in 1994 than in 1995. The volume traded in 1995 was only 27 percent of the district's CVP allocation for that year, while the volume traded in 1994 was 45 percent of the allocation for that year. In 1993, the volume traded was 51 percent of the CVP allocation, and in 1996 the volume traded was 28 percent of the allocation. Even though the volume of water traded was greater in 1995 and 1996, farms made fewer trades in those years than in the water-short years of 1993 and 1994. Farms made 2,580 trades in 1994, the year with the most trades and the smallest water allocation. Farms made the fewest trades in 1996 (1,673 trades). The average size of a trade varies significantly from year to year. It was smallest in 1994 (110 AF per trade) and largest in 1996 (236 AF per trade). When measured according to farm participation rates, the market was most active in 1993. A total of 226 farms sold water at least once during the year and 186 farms bought water at least once during the year. 153 farms both bought and sold water. As a share of the total number of farms in Westlands, 64 percent sold at least once, 53 percent bought at least once and 43 percent both bought and sold.

It is well known that Westlands growers operate under nearly continuous conditions of water scarcity. The Westlands water market is an adaptation to this scarcity, and the innovative behavior of these growers is a model for how other California farmers can respond to future changes in water supplies. Many Westlands growers obviously find merit in water marketing, and there is good reason to believe that landowners in other parts of the Valley can learn to operate in this way as well.

2. Trading Patterns by Priority Area

Westlands is divided into three priority areas (1, 2 and 3). When Westlands receives its full allocation, land in priority area 1 receives 2.2 acre-feet per acre and land in priority areas 2 and 3 receive 1.5 acre-feet per acre. During dry years, supplies are first reduced from area 3, then area 2 and finally area 1. Thus, during some years, priority area 1 may receive its full 2.2 acre-feet per acre while the other two areas receive nothing. Priority area 1 has the most senior rights, followed by area 2 and then 3.[1]

In each of the four years considered, net transfers in area 1 were negative, and net transfers in areas 2 and 3 were positive. The movement of water from area 1 to areas 2 and 3 was greatest in 1996 and least in 1994. In 1996, the net loss to area 1 was 114,241 AF, the net gain to area 2 was 101,272 AF and the net gain to area 3 was 12,969 AF. In 1994, the net loss to area 1 was 44,532 AF, the net gain to area 2 was 36,018 AF and the net gain to area 3 was 8,514 AF. While the net transfers in each area varied significantly from year to year, the net transfers in terms of the share of the total annual CVP allocation were fairly constant. The loss to area 1 in 1996 represented eight percent of the total CVP allocation of 1,425,000 AF. The loss to area 1 in 1994 represented in seven percent of the total CVP allocation of 637,000 AF. In 1993 and 1995, the loss to area 1 represented six percent of the total allocation for the given year.

Significantly, priority area 2 is where most of the perennial crops are grown in the District. This allocation occurs despite the fact that this area has a less stable water supply than area 1. Without an active internal market, it is highly doubtful that growers would be able to produce tree and vineyard crops on area 2's high-quality soil. This is one sense in which water trading can help growers cope with supply fluctuations, as it provides a way to reallocate water supplies to those crops with the greatest level of capital investment in water-short years.

E. Market Trading Patterns by Farm Size

For purposes of this discussion, define a farm to be small, medium or large depending on its total acreage. Small farms are 960 acres of less, medium farms are 960 –

5,760 acres and large farms are greater than 5,760 acres. Depending on the year, 60 to 64 percent of the farms in the district were small farms, 27 to 30 percent were medium farms and 9 to 11 percent were large farm.

In each year considered, market participation rates were greatest among large farms and lowest among small farms. Among small farms, 21 to 32 percent bought in a given year and 30 to 47 percent sold on the market. Among medium sized farms, 43 to 66 percent bought water and 46 to 63 sold water. Finally, 75 to 85 percent of large farms bought water and 59 to 76 percent of large farms sold water.

Due to their smaller size, small farms traded less water in total than medium-sized farms; medium farms also traded less water than large farms. The average number of acre-feet traded was lower in 1994 than in the other years for each size group. The average number of acre feet traded was greatest for medium and large farms in 1995 and greatest for small farms in 1996.

While small farms bought and sold less in total than other types of farms, small farms actually traded more in terms of acre-feet per acre than medium and large farms in each year. Further, whether small farms buy or sell on the market is related to the type of water year. In the water-short year of 1994, small farms bought 0.40 acre-feet per acre on average, and sold only 0.22 acre feet. In 1996, by contrast, small farms bought 0.48 acre-feet per acre on average and sold 0.90. In 1996, medium farms bought 0.28 acre-feet per acre and sold 0.21 acre feet. Large farms bought 0.29 acre-feet per acre and sold 0.21 acre feet.

It is significant that market trades account for a significant fraction of the total water supplies of small farms. Assuming a farm is located in Priority Area 1, it received a CVP allocation of 2.2 acre feet per acre in 1996. Thus, if a small farm purchased 0.48 acre-feet per acre, it increased its initial allocation by 22 percent. If a small farm sold 0.90 acre-feet per acre, it reduced its initial supply by 41 percent. Of course, many farms both bought and sold water. If a small farm bought 0.48 acre-feet per acre and sold 0.90 acre feet, these trades

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[1] Priority area 3 encompasses a relatively small area of the district, and thus does not account for a large share of the trading activity.

represent a net reduction in supply of 0.42 acre feet per acre which is a 19 percent decrease from its initial CVP supply.

This research indicates that small farms rely on the water market more than large farms. More important, it shows that the market is an especially important supply source for small farms during water-short years. While these results are preliminary, they are highly suggestive, and indicate that water markets may have important equity consequences in addition to their efficiency benefits.

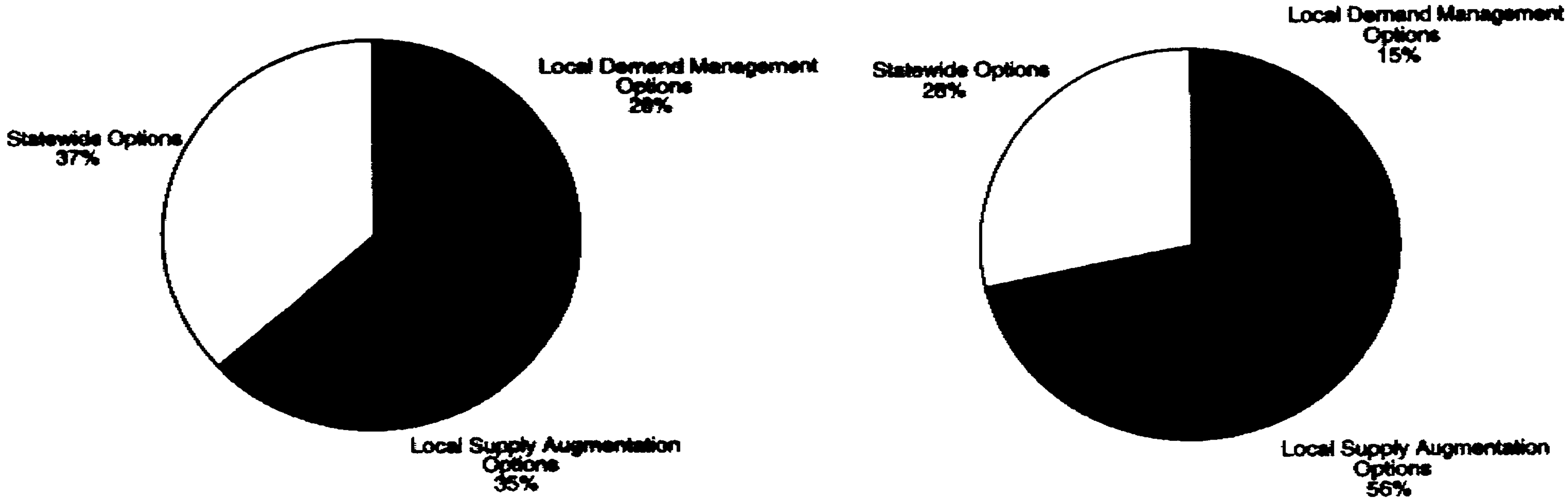
IV. RECOMMENDATIONS AND CONCLUSIONS

The CALFED efficiency analysis and the closely related Bulletin 160 are not useful documents with which to assess the desirability of CALFED alternatives or proposed common elements. A more useful analysis would define water supply and demand with reference to economic values rather than use the simple physical efficiency approach and ad hoc ordinal ranking employed.

A large body of economic literature demonstrates that farmers and urban water consumers respond in rational and predictable ways to changes in water price and availability. Well-designed financial incentives can lead to improved water allocations and maximize the economic value of existing supplies. No decisions regarding provision of additional supplies should be made until CALFED identifies and evaluates these types of incentives.

Figure 1:
Comparison of Average Year and Drought Year Distribution of Supply- and Demand- Side California Water Plan 2020 Options

(Category as % of Total Plan Options)



Average Year **Drought Year**

Source: Based on Table 10-3, Bulletin 160-98 Public Review Draft, p. 10-7.

Save San Francisco Bay Association

1736 Franklin Street, 3rd Floor Oakland, CA 94612

CALFED Bay-Delta Program
1416 Ninth Street, Suite 1155
Sacramento, CA 95814

Attn: Rick Breitbenbach

BY COURIER

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